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# Designation: E1079 − 21名称： E1079 - 21

**Standard Practice for透射密度计**

Calibration of Transmission Densitometers1透射密度计校准标准操作规程1

This standard is issued under the fixed designation E1079; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (s) indicates an editorial change since the last revision or reapproval.本标准以固定编号 E1079 发布；紧跟编号之后的数字表示最初通过的年份，如为修订，则表示最后修订的年份。 括号中的数字表示最近一次重新批准的年份。 上标ε（s）表示上次修订或重新批准后的编辑改动。

## Scope范围

* 1. This practice2 covers the calibration of transmission densitometers used to perform measurements of diffuse optical density on radiographic films (see Note 1).本操作规范2 涵盖用于测量射线胶片漫射光密度的透射密度计的校准（见注释 1）。
  2. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appro- priate safety, health, and environmental practices and deter- mine the applicability of regulatory limitations prior to use.本标准无意解决与使用本标准有关的所有安全问题。 本标准的使用者有责任制定适当的安全、健康和环保措施，并在使用前确定法规限制的适用性。*

NOTE 1—For further information on the design and use of densitometers, the following literature is suggested as additional back- ground information: ISO 5–1:2009, ISO 5–2:2009, ISO 5–3:2009, and注 1-关于密度计设计和使用的更多信息，建议参考以下文献作为额外的基础信息： ISO 5-1:2009、ISO 5-2:2009、ISO 5-3:2009 和

ISO 14807:2001.ISO 14807:2001。

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## Referenced Documents参考文件

* 1. *ASTM Standards:3美国材料与试验协会标准：3*

E1316 Terminology for Nondestructive ExaminationsE1316 无损检测术语

* 1. *ISO Standards:4国际标准化组织标准：4*

ISO 5–1:2009 Photography and Graphic Technology — Density Measurements — Part 1: Geometry and Func- tional NotationISO 5-1:2009 摄影和制图技术 - 密度测定 - 第 1 部分： 几何和功能符号

ISO 5–2:2009 Photography and Graphic Technology — Density Measurements — Part 2: Geometric Conditions for Transmittance DensityISO 5-2:2009 摄影和制图技术 - 密度测定 - 第 2 部分：透射密度的几何条件

1 This practice is under the jurisdiction of ASTM Committee E07 on Nonde- structive Testing and is the direct responsibility of Subcommittee E07.01 on Radiology (X and Gamma) Method.1 本实践由 ASTM 非结构测试委员会 E07 管辖，并由放射学（X 和伽马）方法小组委员会 E07.01 直接负责。

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2 For ASME Boiler and Pressure Vessel Code applications, see related Practice SE-1079 in Section II of that Code.2 有关 ASME 锅炉和压力容器规范的应用，请参见该规范第二部分中的相关实践 SE-1079。

3 For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard’s Document Summary page on the ASTM website.3 有关参考的 ASTM 标准，请访问 ASTM 网站 www.astm.org，或联系 ASTM 客户服务部门 service@astm.org。 有关《ASTM 标准年鉴》卷册信息，请参阅 ASTM 网站上的标准文件摘要页面。

4 Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.4 可向美国国家标准学会 (ANSI) 索取，地址：25 W. 43rd St.

ISO 5–3:2009 Photography and Graphic Technology — Density Measurements — Part 3: Spectral ConditionsISO 5-3:2009 摄影和制图技术 - 密度测定 - 第 3 部分：光谱条件

ISO 14807:2001 Photography — Transmission and Reflec- tion Densitometers — Method for Determining Perfor- manceISO 14807:2001 摄影--透射和反射密度计--确定性能的方法

## Terminology术语

* 1. Definitions—For definitions of terms used in this practice, see Terminology E1316.定义--有关本实践中使用的术语定义，请参见术语 E1316。

## Significance and Use意义和用途

* 1. This practice provides a means for calibrating transmis- sion densitometers used for the measurement of diffuse optical density on radiographic films. A transmission densitometer calibrated in accordance with this practice provides the assur- ance that accurate optical density values of radiographs are obtained.本操作规程提供了校准用于测量射线胶片漫射光密度的透射密度计的方法。 按照本操作规程校准的透射密度计可确保获得射线照片的准确光密度值。

## Apparatus仪器

* 1. Apparatus should consist of the following:仪器应包括以下部分：
     1. A calibrated step tablet covering the optical density range used in production radiographs shall be used. The step tablet may be a NIST X-ray Step Tablet (X-Ray Film Step Tablet Transmission Density Standard 38100C)5, or alternately a step tablet from another supplier that is traceable to the NIST step tablet in the range provided by NIST certification. The step tablet shall have at least five steps with optical densities, which cover the optical density range that is used for production radiographs. A calibration certificate shall be provided with the step tablet indicating the tablet ID and recorded values for the optical density of each step. For suppliers of step tablets other than NIST, the certificate shall indicate conformance of trace- ability to NIST, applicable ISO or ANSI standards (for example, ISO 5–3) used, verification of measurement on a NIST step tablet, the ID number of the step tablet, and calibration date of the step tablet. Precautions should be taken in the storage, handling, and use of the step tablet. In the event it becomes scratched, blemished, or exhibits other signs of deleterious wear, it should be replaced immediately. The NIST应使用校准过的阶梯片，其范围应涵盖生产 X 射线照片中使用的光学密度范围。 阶梯片可以是 NIST X 射线阶梯片（X 射线胶片阶梯片透射密度标准 38100C）5，也可以是其他供应商提供的阶梯片，该阶梯片在 NIST 认证提供的范围内可追溯到 NIST 阶梯片。 阶梯片应至少有五个阶梯，其光学密度应涵盖用于生产射线照片的光学密度范围。 校准证书应与阶梯片一起提供，标明阶梯片 ID 和每个阶梯的光密度记录值。 对于 NIST 以外的阶梯片供应商，证书应注明痕量能力是否符合 NIST、所使用的适用 ISO 或 ANSI 标准（例如 ISO 5-3）、NIST 阶梯片的测量验证、阶梯片 ID 编号以及阶梯片的校准日期。 在储存、处理和使用阶跃片时应采取预防措施。 如果阶梯片出现划痕、瑕疵或其他有害磨损迹象，应立即更换。 NIST

5 Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, http://www.nist.gov.5 可向美国国家标准与技术研究院 (NIST) 索取，地址：100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070，http://www.nist.gov。

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(or alternate, if used) step tablet shall be replaced or recali- brated four years from the date of first use.6(5.1.1.1 所述的透射密度计，可使用直接刻度读数或数字读数显示器，专门用于测量 5.1.1 所述薄膜的光学密度范围。

* + 1. Transmission Densitometers, with either direct-scale readout or digital readout displays specifically manufactured for the purpose of measuring the range of optical densities of films described in 5.1.1 may be used.可使用专门为测量 5.1.1 所述薄膜的光学密度范围而制造的具有直接刻度读数或数字读数显示的透射密度计。
    2. Manufacturer’s Operating Instructions for appropriate usage of the transmission densitometer.有关透射密度计的适当使用，请参阅制造商的操作说明。

## Calibration校准

* 1. Full-scale linearity calibration should be performed at least every 90 days during use as follows:在使用过程中，应至少每 90 天进行一次全面线性校准，具体方法如下：
     1. Use the manufacturer’s recommended warm-up time to stabilize circuitry before starting the calibration procedure or the periodic verification checks described in Section 7. Adjust the “0” reading of the densitometer after the warm-up period.在开始校准程序或第 7 节所述的定期验证检查之前，使用制造商建议的预热时间稳定电路。 预热期结束后，调整密度计的 "0 "读数。
     2. Select and measure three steps on the calibrated step tablet densities below, above, and near the midpoint of the range that is used for production radiographs.在校准后的阶梯片上选择并测量三个阶梯，其密度分别低于、高于和接近用于生产射线照片的范围的中点。
     3. Compare the measured optical densities with the actual density values on the calibrated step tablet or the density values listed on the calibration certificate. Calibrate the densitometer, in accordance with manufacturer recommendations, in order to achieve measured densities which are as close as possible to the actual density values on the step tablet. If the densitometer has been calibrated properly, the measured optical densities at the three steps should not vary more than 60.05 from the actual step tablet density values. If any of the measured density values vary more than 60.05 from the density values on the step tablet, the linearity of the densitometer is out of tolerance and should be taken out of service until corrected and recalibrated.将测得的光学密度与校准过的阶梯片上的实际密度值或校准证书上列出的密度 值进行比较。 根据制造商的建议校准密度计，使测量密度尽可能接近阶梯片上的实际密度值。 如果密度计校准正确，则三个阶梯的测量光密度与实际阶梯片剂密度值的差异不应超过 60.05。 如果测得的任何密度值与阶梯片上的密度值相差超过 60.05，则密度计的线性度超出了公差范围，应停止使用直至校正和重新校准。
  2. Any densitometer that is dropped, repaired, or has had critical parts replaced should be recalibrated prior to use.任何密度计在跌落、修理或更换过重要部件后，都应在使用前重新校准。

## Periodic Verification定期校验

* 1. Periodic calibration verification checks using the proce- dure described in Section 6 should be performed at the使用第 6 节所述程序进行定期校准验证检查，应在 NIST 标准的有效期内进行。

6 Expiration interval of the NIST or alternate step tablet may be different than the requirements of this practice. Unless otherwise specified, requirements of this practice shall apply.6 NIST 或替代阶跃平板的有效期可能与本操作规范的要求不同。 除非另有规定，应适用本操作规程的要求。

beginning of each shift, after 8 h of continuous operation, or change of apertures, whichever occurs first.在每班开始时、连续运行 8 小时后或更换光圈时进行，以先发生者为准。

* + 1. If the verification reading is within 60.05 of the optical density values listed on the calibration step tablet or calibration certificate, the densitometer is ready for continued use. If the optical density values are not within the tolerance, recalibration of the densitometer is required, and it shall be performed in accordance with Section 6.如果校验读数在校准步骤片或校准证书所列光密度值的 60.05 范围内，则密度计可继续使用。 如果光密度值不在公差范围内，则需要重新校准密度计，校准应按照第 6 节进行。
    2. If the verification check shows a variation greater than 60.05, then all radiographs examined since the last acceptable density check shall be subject to a re-verification of the measured optical densities after the densitometer has been recalibrated.如果验证检查显示差异大于 60.05，则在重新校准密度计后，应对上次合格密度检查后检查的所有射线照片重新验证所测量的光学密度。
  1. Consult the Manufacturer’s Technical Manual for troubleshooting information.有关故障排除信息，请查阅制造商的技术手册。

## Records and Associated Documentation记录和相关文件

* 1. Note the densitometer calibration and periodic verifica- tion acceptance condition in an appropriate log. This log shall also indicate the date the calibration/verification was per- formed and the identification of the individual who performed the calibration/verification and shall be traceable to the appli- cable densitometer. The retention period for calibration/ verification documentation should be agreed upon by the purchaser and supplier.在适当的日志中记录密度计校准和定期核查验收情况。 该日志还应注明校准/验证的日期和执行校准/验证的人员的身份，并可追溯至应用电缆密度计。 校准/验证文件的保存期限应由采购商和供应商商定。
  2. An alternative calibration/verification documentation system may be used provided the calibration/verification trace- ability requirements identified in 8.1 can be satisfied and documented properly. A pressure sensitive label or tag that indicates the date the calibration/verification was performed, and the identification of the individual performing the calibration/verification, may be applied to the densitometer for verification of the calibration reference check recorded in the calibration/verification log.可使用另一种校准/核查记录系统，但必须满足 8.1 中确定的校准/核查跟踪能力要求，并妥善记录。 可在密度计上贴上标明校准/核查日期和校准/核查人员身份的压敏标签或标记，以核查校准/核查日志中记录的校准参考检查。
  3. Note and record the date of first use of the calibration/ verification step tablet so that the requirements of 5.1.1 can be satisfied.注意并记录校准/验证步骤片的首次使用日期，以便满足 5.1.1 的要求。

## Keywords关键词

* 1. calibration; densitometer; optical density; periodic veri- fication; radiographic film校准；密度计；光密度；定期校验；射线胶片

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